

MULTIOBJECTIVE RELIABILITY-BASED DESIGN OPTIMIZATION OF STOCHASTIC STRUCTURAL SYSTEMS USING A COMPROMISE PROGRAMMING STRATEGY

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Abstract

Structural design often requires establishing an appropriate tradeoff between several desirable but conflicting objectives. For structural dynamical systems under stochastic excitation, relevant performance metrics include first-passage failure probability measures [1] and suitable cost functions. In this context, the formulation of multiobjective reliability-based design optimization (MRBDO) problems represents a reasonable solution approach. This allows incorporating inherent uncertainties about system behavior into system performance measures while yielding valuable insight into the tradeoff between such measures. In this regard, this work presents an effective technique for exploring specific tradeoff solutions, i.e., Pareto points. To this end, a compromise programming strategy is implemented, in which a weighted Chebyshev metric based on aspiration levels determines the target tradeoff between objectives via a single-objective problem [2]. The latter is solved by means of a two-phase stochastic search technique that sequentially explores the corresponding feasible and optimum solution sets [3]. Rather than a single final solution, the approach yields a set of nearly equivalent compromise designs. This yields valuable sensitivity information and provides increased flexibility for the overall design process. For improved numerical efficiency, an adaptive surrogate model is formulated for estimating the reliability measures. An application example that includes a three-dimensional building model equipped with nonlinear devices and subject to stochastic ground excitation is presented to illustrate the capabilities of the proposed approach

References

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